MAP GQ-1611

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

GEOLOGIC MAP OF THE WILSON MOUNTAIN QUADRANGLE, CATRON AND GRANT COUNTIES, NEW MEXICO

By James C. Ratté and William E. Brooks

GEOLOGIC QUADRANGLE MAP
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RATTÉ AND BROOKS—GEOLOGY, WILSON MOUNTAIN QUAD., N. MEX. 1:24,000 MAP GQ-1611

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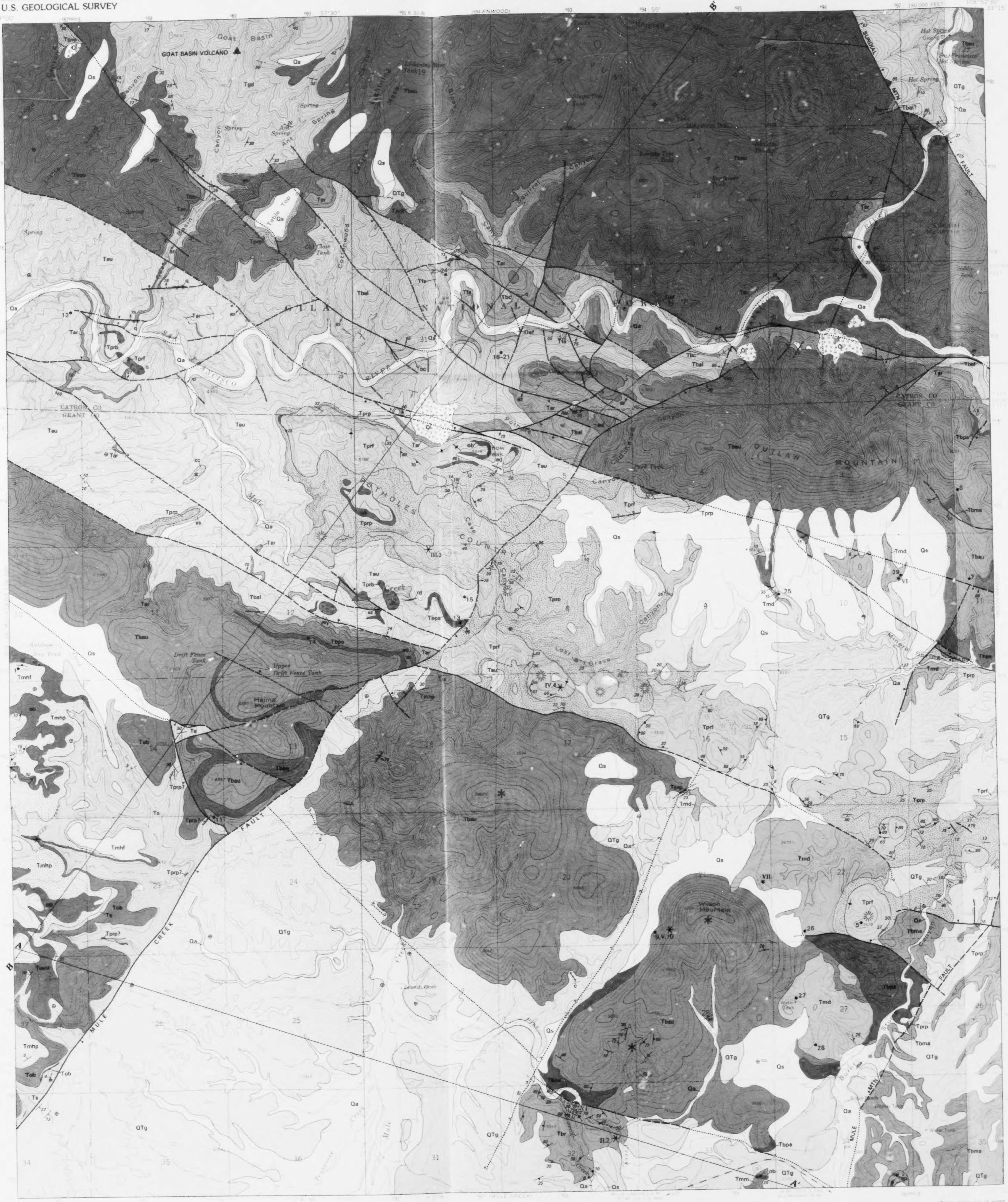


Base from U.S. Geological Survey, 1985
10,000-foot grid based on New Mexico coordinate system, west zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

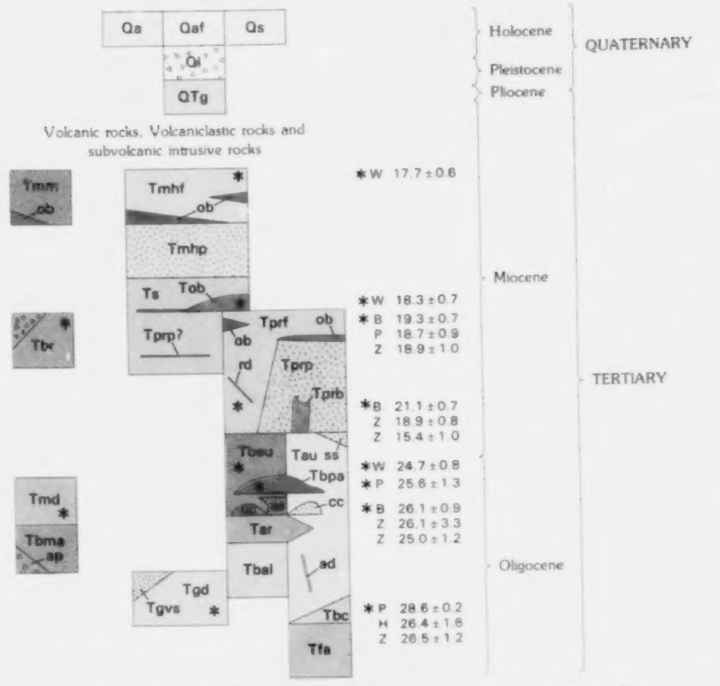
SCALE 1:24 000
1 MILE
1 KILOMETER
CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

NEW MEXICO
QUADRANGLE LOCATION

Geology mapped [illegible] assisted by W.E. Brooks [illegible]

CORRELATION OF MAP UNITS

[Radiometric age in millions of years[1]]



[1] Zircon fission track ages (z) analyzed by C. W. Naeser. K-Ar ages (W, whole rock, B, biotite, P, plagioclase, H, hornblende) by R. F. Marvin and H. H. Mehnert

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS AND BASIN-FILL SEDIMENTARY ROCKS

Qa **Alluvium (Holocene)**—Deposits underlie active flood plains and terraces of major streams; may include some sheetwash deposits

Qaf **Alluvial-fan deposits (Holocene)**—Unconsolidated boulder and gravel fans at mouths of some tributaries of San Francisco River

Qs **Sheetwash (Holocene)**—Unconsolidated sediment that obscures bedrock, as on the south slopes of Outlaw Mountain; grades into stream alluvium in places

Ql **Landslide debris (Holocene and (or) Pleistocene)**

QTg **Gila Conglomerate (Pleistocene to Miocene)**—Fanglomerate from local sources. Typically consists of fine- to coarse-grained sandstone and poorly sorted, poorly bedded conglomerate containing rhyolite and andesite clasts in a pink, buff, or gray sandy matrix. Black pebbles of obsidian (Apache tears) are widespread in the Mule Creek graben. Commonly grades into coarse mudflow breccia at basin margins. Exposed thickness within the Mule Creek graben is about 140 m, which is probably about maximum as indicated by outcrops of the underlying andesite lava flows in the Mule Creek quadrangle to the south (Ratté and Brooks, 1983). Thickness of conglomerate in northeast corner of quadrangle is more than 200 m

VOLCANIC ROCKS, VOLCANICLASTIC ROCKS, AND SUBVOLCANIC AND INTRUSIVE IGNEOUS ROCKS

Rhyolite of Mule Creek (Miocene)

Tmhf, ob **Lava flows**—Aphyric, high-silica, alkali-rhyolite domal flows from the Harden Cienega eruptive center along southwestern border of quadrangle. Unit **ob**, commonly at the base of the flows, consists of brown, pumiceous glass that grades upward into gray to black perlitic obsidian and obsidian breccia. Extensive ledges of partly hydrated, perlitic obsidian contain nonhydrated obsidian nodules (marekanites) which, when released by weathering, become the Apache tears that are widespread on the surface and within the Gila Conglomerate in this region. Age shown in Correlation is from locality about 1 km south of tank in Antelope Creek in Big Lue Mountains quadrangle adjacent to west edge of Wilson Mountain quadrangle. Thickness of flows is as much as 60 m and unit **ob** as much as 25 m

Tmhp **Pyroclastic rocks**—Bedded and crossbedded tuff and lapilli tuff and pyroclastic surge deposits, showing some reworking, form coalescing tuff rings around vents of the Harden Cienega center. Thickness 0 to about 30 m

Tmm, ob **Rhyolite flow**—Aphyric, high silica alkali rhyolite and obsidian (unit **ob**) from the Mule Mountain eruptive center in Mule Creek quadrangle to south (Ratté and Brooks, 1983) extends about 300 m into southeastern part of quadrangle south of New Mexico Highway 78. Thickness 0 to about 30 m

Tob **Olivine basalt (Miocene)**—Flows of gray, aphanitic basalt consist of sodic labradorite, olivine altered largely to iddingsite, and augitic pyroxene with microdiabase texture. Present in southwest part of quadrangle, where may be derived from local vent marked by cinders and bombs on west side of Mule Creek fault, near stock pond in sec. 27, T. 13 S., R. 21 W. Two thin discontinuous flows a few meters

thick are interlayered with volcaniclastic
Thickness of main flow 0 to about 50

Ts, Tprp? **Volcaniclastic sedimentary rocks (Miocene**
poorly sorted fanglomerate, and finer
Local tuffaceous character, interlayered
distinguish these rocks from the Gila Co
(unit **Tprp?**), 0-10 m thick, consists of be
flow of uncertain correlation with rhyol
Thickness 0-100 m

Rhyolite of Potholes Country (Miocene)
trusive complex; crops out mainly in nor

Tprf, rd, ob **Domal rhyolite, lava flows,** plugs, and
and dikes (unit **rd**) locally shown separa
to porphyritic rhyolite containing as mu
in diameter) of sanidine, oligoclase, and
oxide and sphene; lithic fragments rare
as 300 m exposed in vent on north sid
Mountain (fig. 1)

Tprp **Pyroclastic rocks**—Present in coalescing
Bedded lapilli-tuff breccia consists
crossbedding of pyroclastic rocks
deposits consist locally of fine, brea
into coarse block and ash breccia
andesite blocks commonly 10-20 cm
1 m in diameter (fig. 3). Deposits
pyroclastic flows. Thickness 0 to about

Tprb **Volcanic breccia pipes and breccia dike**
and 400 m; breccia pipes and dikes
a rhyolite breccia matrix that ranges from
(fig. 4). Downstream from the mouth of
Francisco River, a large breccia
river level. Other breccia pipes and dikes
sides of Mule Creek (fig. 5)

Tbr **Rhyolite of The Box (Miocene)**—Forms
The Box, at southwest end of Wilson M
and Sawmill Creeks. Breccia patter
at margin of dome. Rhyolite contains
mm) including oligoclase-andesine
opaque oxide, zircon, and brown
spherulitic, glassy matrix. Exposed thick

Bearwallow Mountain Formation of Elston,
of andesite and basaltic andesite erupted fr
tain volcano on south side of Potholes Co
an unnamed mountain between Wilson
more satellite vents likely were localized
Flat, north of San Francisco River, are p
around Brushy Mountain (known locally
quadrangle. Andesites from Wilson Mo
volcano probably overlap near Outlaw M
with similar flows centered on Brushy Mo
in Mule Creek and Steeple Rock quad

Tau, ss, ad, cc **Andesite, undivided**—Shown only within
Creek fault, where rhyolite marker uni
flows are discontinuous or absent. Inclu
Tbau and **Tbal**), which overlie Bloodgoo
(unit **ss**), and andesite dikes (unit **ad**)
a partly exhumed cinder cone or other
1 km above its mouth. Thickness of the

Tbau, ss, cc **Upper andesite**—Mainly dark- to mediu
finely porphyritic lava flows less than
the Bearwallow Mountain Formation
flows have sparse small phenocrysts and
pyroxene, and relict olivine in a pilotax
contain hypersthene. Volcaniclastic sand
(unit **cc**) occur at or near the base of the

Tbaa **Coarsely porphyritic andesite**—Gray to
fine-grained andesite (unit Tbau) on Ha
tain, and east of Outlaw Mountain, and
of Mule Creek. Characterized by abundan
cm long, and smaller augitic pyroxene
microlitic to microdiabase matrix. Age
Ranch quadrangle along Burnt Stump C
Mineral Spring Canyon. Thickness 0 to

Tbal **Lower andesite**—Reddish-brown to gray
flows a few tens of meters thick. Overlies
Francisco River, and separated from upp
Formation by rhyolite of Angel Roost.
pyroxene are generally altered to iddings
subophitic or microdiabasic rather than m
flows. Thickness about 250 m

Tar **Rhyolite of Angel Roost (Oligocene)**—Four
flow units at Angel Roost, each about
vent zone at the west end of Outlaw M
are thickest. Lesser accumulations form
northern half of the quadrangle. Varia
fragments give a crude layering to the

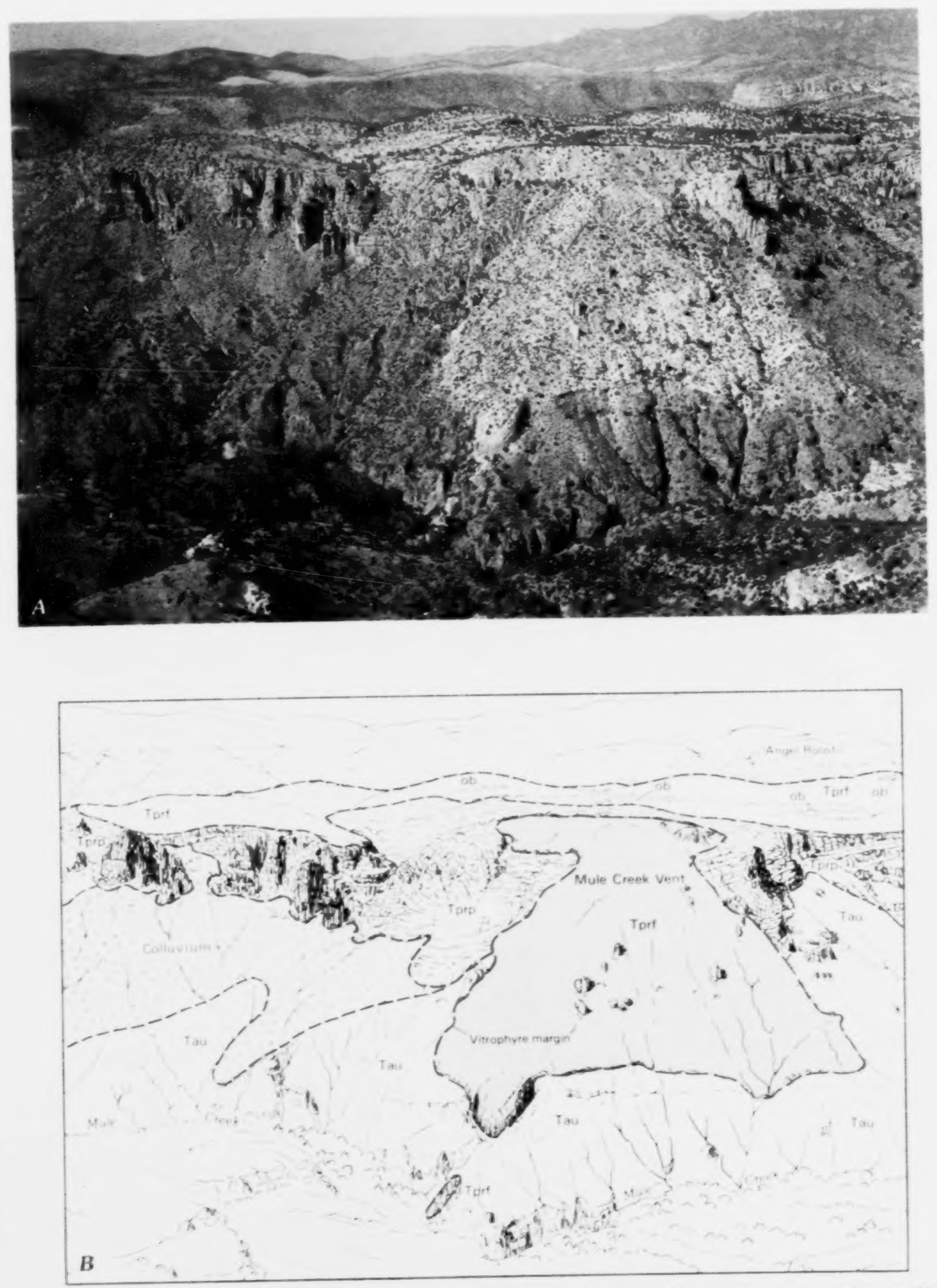
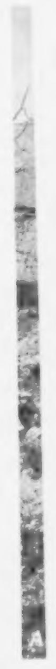
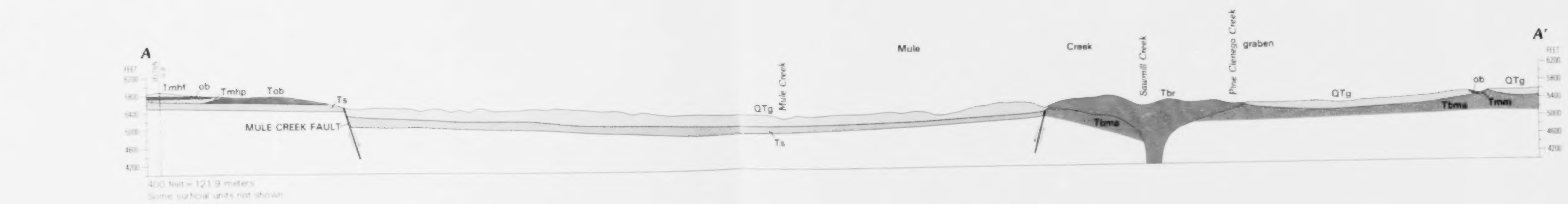
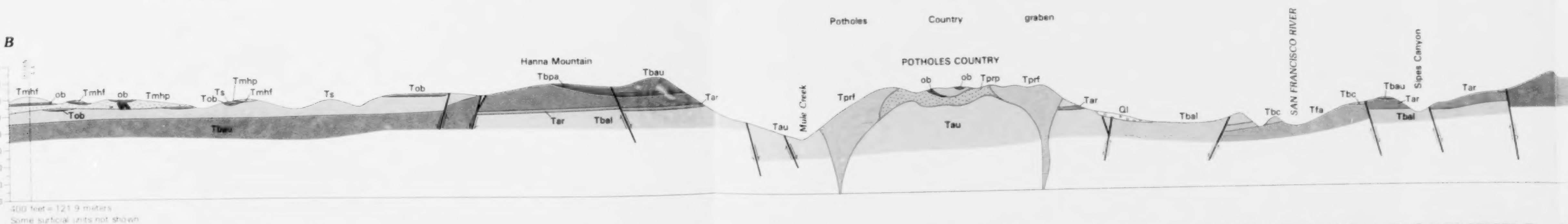


Figure 1.—*A*. Mule Creek vent, one of several vents of rhyolite of Potholes Country (Trp) which are aligned west-northwest within the Potholes Country graben. View is across canyon of Mule Creek from south rim, north of Hanna Mountain. Vertical relief from Mule Creek to north canyon rim is about 350 m (1100 ft). Rhyolite intrudes dark-brown lava flows of Bearwallow Mountain Formation (Tau) and cuts pyroclastic breccia layers (Tprp) that represent an early pyroclastic stage in the eruption of the rhyolite of Potholes Country (Tprf). *B*. Sketch of key features shown in photograph.





400 feet = 121.9 meters
Some surficial units not shown



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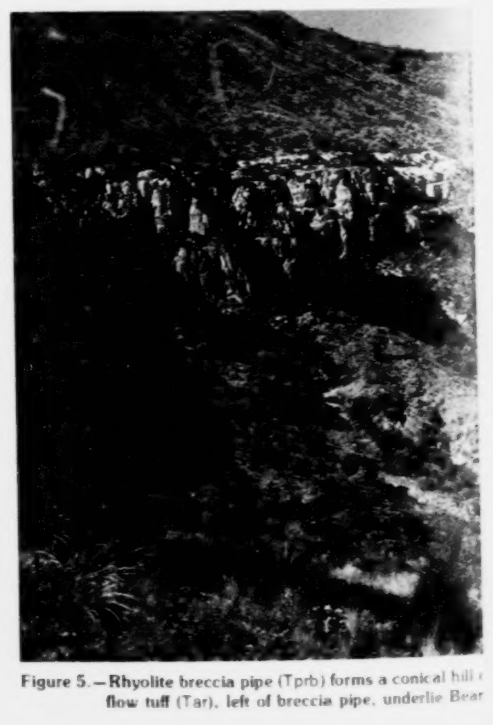

Figure 5.—Rhyolite breccia pipe (Tprb) forms a conical hill
flow tuff (Tar), left of breccia pipe, underlie Bear

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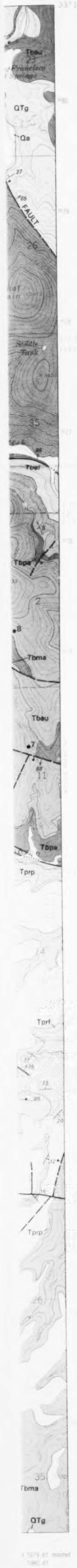
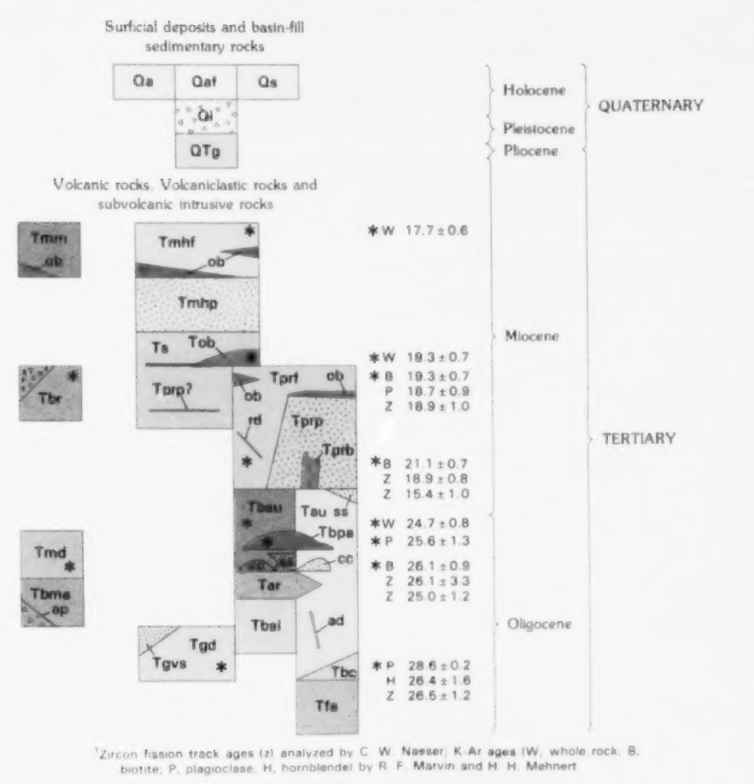


CORRELATION OF MAP UNITS

[Radiometric age in millions of years¹]



¹Zircon fission track ages (z) analyzed by C. W. Naeser; K-Ar ages (W, whole rock; B, biotite; P, plagioclase; H, hornblende) by R. F. Marvin and H. H. Mehnert

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Ts, Tprp? **Volcaniclastic sedimentary rocks (Miocene)**—Pink, brown, and gray conglomerate, poorly sorted fanglomerate, and finer grained volcaniclastic sedimentary rocks. Local tuffaceous character, interlayered tuff, and lack of Apache-tear clasts generally distinguish these rocks from the Gila Conglomerate in this area. Interlayered tuff (unit **Tprp?**), 0-10 m thick, consists of bedded ashfall and poorly welded pyroclastic flow of uncertain correlation with rhyolites of Potholes Country or Angel Roost. Thickness 0-100 m

Rhyolite of Potholes Country (Miocene)—High-silica, alkali rhyolite extrusive and intrusive complex; crops out mainly in northwest-trending Potholes Country graben

Tprf, rd, ob **Domal rhyolite, lava flows, plugs, and dikes**—Obsidian or vitrophyre (unit **ob**) and dikes (unit **rd**) locally shown separately. Rhyolite ranges from aphyric felsite to porphyritic rhyolite containing as much as 15 percent phenocrysts (1-2 mm in diameter) of sanidine, oligoclase, and quartz; sparse accessory biotite, opaque oxide and sphene; lithic fragments rare. Thickness 0 to about 100 m; as much as 300 m exposed in vent on north side of lower Mule Creek north of Hanna Mountain (fig. 1)

Tprp **Pyroclastic rocks**—Present in coalescing tuff rings around rhyolite vents and plugs. Bedded lapilli-tuff breccia consists largely of small pumice fragments. Large-scale crossbedding of pyroclastic rocks commonly marks vents (fig. 2). Initial eruptive deposits consist locally of fine, brown, sandy tuff as thick as 10-20 m, which grades into coarse block and ash breccia that contains as much as 50 percent or more andesite blocks commonly 10-20 cm in diameter and a few blocks larger than 1 m in diameter (fig. 3). Deposits include some thin, graded ashfall beds and some pyroclastic flows. Thickness 0 to about 200 m

Tprb **Volcanic breccia pipes and breccia dikes**—Maximum dimensions between 200 and 400 m; breccia pipes and dikes consist predominantly of andesite blocks in a rhyolite breccia matrix that ranges from less than 1 percent to 20 percent or more (fig. 4). Downstream from the mouth of Mule Creek, on the southeast side of San Francisco River, a large breccia dike grades into nonbrecciated rhyolite (**Tprf**) at river level. Other breccia pipes and dikes are west of the Mule Creek fault on both sides of Mule Creek (fig. 5)

Tbr **Rhyolite of The Box (Miocene)**—Forms vitrophyre dome about 1 km in diameter at The Box, at southwest end of Wilson Mountain at the junction of Pine Cienega and Sawmill Creeks. Breccia pattern indicates local vent and (or) glassy breccia at margin of dome. Rhyolite contains about 20 percent corroded phenocrysts (1-4 mm) including oligoclase-andesine, quartz, sanidine, and biotite, and accessory opaque oxide, zircon, and brown hornblende in a partly devitrified, locally spherulitic, glassy matrix. Exposed thickness of dome about 80 m

Bearwallow Mountain Formation of Elston, 1968 (Miocene and Oligocene)—Flows of andesite and basaltic andesite erupted from local shield volcanoes. Wilson Mountain volcano on south side of Potholes Country graben was probably centered near an unnamed mountain between Wilson and Hanna Mountains, although one or more satellite vents likely were localized on Wilson Mountain. Flows under Juniper Flat, north of San Francisco River, are part of larger shield centered to the north around Brushy Mountain (known locally as "Glenwood Brushy") in Glenwood quadrangle. Andesites from Wilson Mountain volcano and Glenwood Brushy volcano probably overlap near Outlaw Mountain. These andesites also correlate with similar flows centered on Brushy Mountain (known locally as "Radar Brushy") in Mule Creek and Steeple Rock quadrangles to the south

Tau, ss, ad, cc **Andesite, undivided**—Shown only within Potholes Country graben, west of Mule Creek fault, where rhyolite marker units commonly interlayered with the andesite flows are discontinuous or absent. Includes upper and lower andesite flows (units **Tbau** and **Tbal**), which overlie Bloodgood Canyon Tuff, volcaniclastic sandstone (unit **ss**), and andesite dikes (unit **ad**). Cinder and bomb layers (unit **cc**) mark a partly exhumed cinder cone or other near-vent deposit west of Mule Creek about 1 km above its mouth. Thickness of flows 400-500 m

Tbau, ss, cc **Upper andesite**—Mainly dark- to medium-gray or reddish-brown, aphanitic to finely porphyritic lava flows less than 10 m thick; separated from lower flows of the Bearwallow Mountain Formation by rhyolite of Angel Roost. Typical andesite flows have sparse small phenocrysts and microphenocrysts of plagioclase, augitic pyroxene, and relict olivine in a pilotaxitic matrix. Other distinctive glassy flows contain hypersthene. Volcaniclastic sandstone (unit **ss**) and cinder cone deposits (unit **cc**) occur at or near the base of this flow sequence. Thickness about 500 m

Tbpa **Coarsely porphyritic andesite**—Gray to reddish-brown lava flows interlayered with fine-grained andesite (unit **Tbau**) on Hanna Mountain, south of Wilson Mountain, and east of Outlaw Mountain, and interlayered in unit **Tau** on north side of Mule Creek. Characterized by abundant andesine-labradorite phenocrysts, 3-4 cm long, and smaller augitic pyroxene crystals, with or without olivine relicts, in microlitic to microdiabase matrix. Age shown in Correlation is from locality in Moon Ranch quadrangle along Burnt Stump Canyon about 1 km above junction with Mineral Spring Canyon. Thickness 0 to about 60 m

Tbal **Lower andesite**—Reddish-brown to gray, fine-grained, commonly amygdaloidal lava flows a few tens of meters thick. Overlies Bloodgood Canyon Tuff along the San Francisco River, and separated from upper andesite of the Bearwallow Mountain Formation by rhyolite of Angel Roost. Sparse mafic phenocrysts of olivine and pyroxene are generally altered to iddingsite and serpentine; matrix is commonly subophitic or microdiabasic rather than microlitic as is prevalent in upper andesite flows. Thickness about 250 m

Tar **Rhyolite of Angel Roost (Oligocene)**—Four nonwelded to partly welded pyroclastic-flow units at Angel Roost, each about 30-40 m thick, define a probable rhyolite vent zone at the west end of Outlaw Mountain, where these pyroclastic rocks are thickest. Lesser accumulations form a widespread stratigraphic marker in the northern half of the quadrangle. Variable concentrations of pumice and lithic fragments give a crude layering to the tuff and lapilli breccia, which consists of yellow to white pumice, sparse feldspar and quartz crystal fragments, 1-2 mm long, and 5-10 percent lithic fragments that are mainly gray to reddish-gray, porphyritic rhyolite and buff, aphanitic rhyolite. These rocks generally differ from younger rhyolite pyroclastic formations (**Tprp** and **Tmhp**) by absence of perlitic rhyolite lithics and crossbedded airfall. Thickness 0 to about 150 m

Tmd **Dacite of Mineral Spring Canyon (Oligocene)**—Domal accumulation of lava flows and breccia north and east of Wilson Mountain and scattered outcrops along Mineral Spring Canyon on southern slopes of Outlaw Mountain. Rocks typically contain 5-10 percent phenocrysts, 1-2 mm long, and microphenocrysts of cloudy, zoned, lath-shaped andesine with corroded cores, relicts of altered oxyhornblende and biotite, and minor augitic pyroxene. East of Wilson Mountain, some dacitic lavas contain hypersthene. Maximum exposed thickness about 60 m

Tbma, ap **Andesite of Bear Mountain (Oligocene)**—Fine-grained andesite flows contain sparse, small (less than 1 mm) andesine-labradorite and altered mafic phenocrysts, mainly augitic pyroxene. Massive closely jointed outcrops of fine- to medium-grained diabase (unit **ap**) may represent a small andesite plug in southeast corner of quadrangle. Exposed thickness is about 40 m

Tgd, Tgvs **Dacite of Goat Basin (Oligocene)**—Mainly hornblende-bearing dacite agglomerate, flows, and tuffs, which form the Goat Basin volcanic cone; includes some pyroxene andesite flows that flank the cone. Tuffs and volcaniclastic rocks (unit **Tgvs**) shown separately in Lloyd Canyon in northwest corner of quadrangle. Ages reported in Correlation of Map Units are from sample locality in northern half of cone, in Glenwood quadrangle. Thickness about 400 m

Tbc **Bloodgood Canyon Tuff (Oligocene)**—Moderately to densely welded rhyolite ash-flow tuff typically containing 10-20 percent quartz and chatoyant sanidine phenocrysts in a completely recrystallized granophyric matrix; rare biotite and relict sphene. Present only along San Francisco River near Angel Roost. Thickness about 30 m

Tfa **Andesite of San Francisco River (Oligocene)**—Typically reddish-gray to gray, fine-grained andesite and basaltic andesite flows that underlie Bloodgood Canyon Tuff. Abundant microphenocrysts and rare phenocrysts larger than 1 mm include sodic labradorite and augitic pyroxene in a very fine grained matrix containing both flow-aligned and randomly oriented plagioclase microlites. Olivine is absent in contrast to flows of the Bearwallow Mountain Formation that overlie Bloodgood Canyon Tuff. These calc-alkaline andesites are chemically distinct from the Bearwallow Mountain Formation. Exposed thickness at San Francisco River is about 200 m

40 **Contact**—Showing dip; dashed where inferred or approximately located

70 **Fault**—Showing dip; dashed where inferred or approximately located; dotted where concealed; queried where uncertain; ball and bar on downthrown side

Breccia zone—Showing dip; may be a fault

Strike and dip of beds
10 **Inclined**
3 **Apparent**
Direction of dip
⊕ **Horizontal**

Strike and dip of flow layers or compaction foliation
22 **Inclined**
Vertical

Joints—Vertical

Veins—q, quartz; c, calcite

Prospect

Sample locality
*¹ **Age sample**
●¹ **Chemical analysis**
✳1,1 **Combined age and chemical analysis**

Altered rocks

Volcanic vent or probable vent area
✳ **Andesite volcano**
* **Andesite cinder cone**
☼ **Rhyolite**—only some of the larger and more obvious of the many coalescing vents of the rhyolite of Potholes Country are shown
▲ **Dacite stratovolcano**

NOTES

LOCATION

The Wilson Mountain quadrangle is in the Gila National Forest about 6 km south of Glenwood, N. Mex., and it straddles the Catron County-Grant County line. The quadrangle is west of U.S. Highway 180 and north of New Mexico Highway 78 at Mule Creek, N. Mex. The San Francisco River flows east to west across the northern half of the quadrangle, which includes part of the Lower San Francisco Wilderness Study Area and contiguous Roadless Area (Ratté, 1982); the southern half of the quadrangle is mostly private ranch land.

GEOLOGY

The Wilson Mountain quadrangle is in the southwestern part of the mid-Tertiary Mogollon-Datil volcanic field peripheral to the Mogollon plateau of Elston (1965), and is near the junction of the northwest-trending Mangas trench (Trauger, 1965) and the northeast-trending Morenci-Reserve fault zone. This area is structurally depressed relative to the mid-Tertiary caldera complex to the northeast in the Mogollon Mountains.

The rocks in the quadrangle are all middle Tertiary volcanic rocks, which range in composition from alkali basalt to high-silica alkali rhyolite (table 1, fig. 6) and basin-fill volcaniclastic rocks. The oldest rocks are pyroxene andesite flows along the San Francisco River (unit **Tfa**); they are overlain by the Bloodgood Canyon Tuff, approximately 29 m.y. old (Ratté and others, 1984), which is a stratigraphic marker that relates the local volcanic sequence to the main part of the Mogollon-Datil volcanic field. In the northwest corner of the quadrangle, the southern flanks of the Goat Basin stratovolcano of hornblende dacite and andesite (26-28 m.y. old) are partly exhumed from beneath younger andesite lava flows. The center of this volcano is in the Glenwood quadrangle, to the north, where it is intruded by small rhyolite dikes; a magnetic low over the cone indicates a possible larger silicic body beneath it (Martin, 1982; Ratté and others, 1982).

Along the San Francisco River, Bloodgood Canyon Tuff overlies older andesite flows and is overlain by a thick sequence of andesite flows within which pyroclastic flows of the rhyolite of Angel Roost are interlayered. The pyroclastic flows extend throughout the northern half of the quadrangle, where they are a useful stratigraphic marker, but they are thickest (about 200 m) at Angel Roost, and probably were erupted from a local source there or nearby under Outlaw Mountain. The thick andesite flows above the rhyolite of Angel Roost on Outlaw Mountain are reversely magnetized, at least in part, so they probably are not the cause of the positive dipole magnetic anomaly on Outlaw Mountain (Martin, 1982), but a rhyolite vent or intrusive could be.

The post-Angel Roost andesite flows are 23-26 m.y. old and form a number of small- to moderate-sized shield volcanoes. In the northern half of the quadrangle, the andesite flows (unit **Tbau**) were probably erupted from a volcano centered on Brushy Mountain in the Glenwood quadrangle to the north, whereas flows of approximately the same age in the southern part of the quadrangle probably were erupted from a small shield volcano centered on the mountain that lies between Wilson Mountain and Hanna Mountain. The andesitic vents in this area seem to be aligned on a west-northwest-trending rift that may also localize a somewhat larger andesitic volcano to the northwest in the Big Lue Mountains quadrangle (Ratté, 1982; Martin, 1982). The voluminous andesitic eruptions were followed by eruptions of high-silica alkali rhyolite from several centers in the region, between about 18 and 20 m.y. ago. Included are the rhyolite of Potholes Country, now confined largely to the Potholes Country graben, and the slightly younger rhyolite of Mule Creek, from the Harden Cienega center in the southwest corner of the Wilson Mountain quadrangle. An isolated rhyolite dome at The Box, at the junction of Sawmill and Pine Cienega Creeks, is of this same age group. Thin flows of olivine basalt (unit **Tob**) underlie and overlie the rhyolite of Mule Creek in this and adjacent quadrangles.

The major structures in the quadrangle, in addition to the constructional volcanic features, are faults that trend generally northeast to north-northeast and northwest to west-northwest. The Mule Creek and Mule Mountains faults bound the northeast-trending Mule Creek graben, which is about 10 km wide in the southern half of the quadrangle. The Potholes Country graben is bounded by west-northwest-trending faults and is 3-5 km wide across the center of the quadrangle. Displacements on these faults are difficult to estimate because the volcanic rocks were erupted from numerous different centers and the units lack continuity and change thickness rapidly. The Mule Creek fault, on the west side of the Mule Creek graben, has a minimum displacement of about 100 m, as estimated from the exposed thickness of Gila Conglomerate on the east side of the fault. The Mule Mountains fault, on the east side of the graben, is less well defined, and pre-existing constructional or erosional topography beneath the Gila Conglomerate must account for the apparent reversals in displacement along it. North of Hanna Mountain, faults on the south side of the Potholes Country graben displace the rhyolite of Angel Roost (**Tar**) down about 250 m to the level of Mule Creek. However, the displacement of the rhyolite on the north side of this graben seems to be much less (on the order of 50-60 m) and is distributed along several anastomosing fractures. The Sundial Mountain fault in the northeast corner of the quadrangle marks the southwest side of the northwest-trending Mangas trench (Trauger, 1965), which separates this area from the Mogollon Mountains to the northeast. The Sundial Mountain fault probably provides deep circulation of ground water for the San Francisco Hot Springs.

The Mule Creek caldera proposed by Rhodes and Smith (1972) is not evident in this quadrangle, and the evidence on which it was proposed probably can be explained largely in terms of the Mule Creek graben (Ratté and Hedlund, 1981; Ratté and Brooks, 1983).

MINERAL RESOURCES

No mining has been done within the Wilson Mountain quadrangle and very little evidence of past prospecting can be seen. However, several veins of quartz and calcite, mainly on the north side of the San Francisco River along west- to northwest-trending faults, contain traces to minor amounts of gold and silver (Ratté and others, 1982). Other mineralized rocks occur in areas of silicified and argillized rocks associated with fumarolic activity near vents of the rhyolite of Potholes Country. Significant metal values were not found in the altered rocks in this quadrangle, but the gold- and silver-bearing veins north of San Francisco River could be peripheral to a subsurface silicic body, which is indicated by a magnetic low corresponding to the exposed rhyolite (Martin, 1982). The mineral resource potential of the silicic rocks in this area is discussed further in a report on the Lower San Francisco Wilderness Study Area and contiguous Roadless Area (Ratté and others, 1982). That potential is enhanced by recent dating of the probable age of mineralization in the nearby Mogollon mining district, where the potassium-argon age of adularia from vein material on the dump of the Last Chance mine was determined to be about 18 m.y. old (R. F. Marvin, written commun., 1981).

The rhyolite of Mule Creek at the Harden Cienega eruptive center along the southwest boundary of the quadrangle and in the adjacent Big Lue Mountains quadrangle contains resources of perlite and pumiceous rhyolite.

Deep circulation of ground water along fractures related to the northwest-trending Sundial Mountain fault in the northeast corner of the quadrangle is the most likely explanation for the hot springs along the San Francisco River. The San Francisco hot springs have been designated a Known Geothermal Resources Area (KGRA) by the U.S. Geological Survey (Muffler, 1979), which means that it is an area that has enough geothermal potential to justify development.

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Table 1.—*Chemical analyses of volcanic rocks in and near the Wilson Mountain quadrangle, New Mexico*

[Analyses by X-ray spectroscopy. Analysts: J. S. Wahlberg, J. Baker, J. Taggart. Leaders (--) indicate absence of normative mineral; <, less than]

	Rhyolite					Olivine basalt	Bearwallow Mountain Formation	
Map unit	Tmhf	Tbr	Tprf	Tprf	Tprf	Tob	Tbau	Tbau
Map no.	1	2	3	4	5	6	7	8
Field no.	W-97-80	W-59-80	W-50-79	W-93-79	E-31-80	W-105-80	W-30-80	W-32-80
Lab no.	D-227247	D-227335	D-225901	D-225902	D-233837	D-227248	D-228854	D-228853
Chemical composition (percent)								
SiO_2	76.1	72.0	74.6	77.2	77.50	48.4	52.3	53.4
Al_2O_3	12.8	13.6	12.0	12.3	12.10	16.3	16.4	16.6
Fe_2O_3	0.94	1.62	0.65	0.67	0.63	12.8	8.92	8.91
MnO	0.06	0.03	0.07	0.06	0.02	0.16	0.11	0.11
MgO	0.1	0.4	<0.1	<0.1	0.10	4.5	4.7	3.9
CaO	0.55	1.47	0.41	0.29	0.04	8.15	7.12	6.94
Na_2O	2.9	2.9	3.4	3.4	3.40	3.2	3.7	3.8
K_2O	4.91	4.72	4.12	4.73	4.23	1.24	2.36	2.64
TiO_2	0.06	0.20	0.09	0.09	0.09	2.44	1.67	1.67
P_2O_5	<0.1	<0.1	<0.1	<0.1	0.10	0.5	0.81	0.75
LOI	0.94	2.20	3.52	0.39	0.64	0.08	2.59	1.66
Total	99.46	99.24	99.08	99.30	98.82	97.77	100.68	100.38
SiO_2 Volatile free	77.3	74.2	78.1	78.1	78.94	50.0	53.6	54.4
Fe_2O_3 and FeO calculated from Fe_2O_3 according to oxidation ratio of LeMaitre, 1976								
Oxidation ratio	0.44	0.46	0.45	0.43	0.44	0.63	0.58	0.56
Fe_2O_3	0.50	0.83	0.34	0.37	0.34	4.44	3.55	3.66
FeO	0.39	0.71	0.28	0.27	0.26	7.53	4.84	4.73
Norms (weight percent)								
Quartz	39.86	34.49	40.01	39.19	42.31	1.72	2.19	3.23
Corundum	1.98	1.33	1.51	1.31	2.13	--	--	--
Orthoclase	29.46	28.76	25.49	28.28	25.48	7.56	14.29	15.88
Albite	24.92	25.31	30.12	29.09	29.30	27.95	32.08	32.73
Anorthite	2.11	6.85	1.45	0.79	0.46	27.30	21.69	20.81
Diopside wo	--	--	--	--	--	4.62	3.79	3.86
en	--	--	--	--	--	2.78	2.68	2.68
fs	--	--	--	--	--	1.59	0.78	0.86
Hypersthene en	0.25	1.03	0.26	0.25	0.25	8.79	9.31	7.20
fs	0.32	0.35	0.22	0.15	0.09	5.04	2.71	2.31
Olivine fo	--	--	--	--	--	--	--	--
fa	--	--	--	--	--	--	--	--
Magnetite	0.74	1.24	0.52	0.54	0.50	6.64	5.27	5.40
Ilmenite	0.12	0.39	0.18	0.17	0.17	4.78	3.25	3.23
Apatite	0.24	0.24	0.25	0.24	0.24	1.22	1.97	1.81

	Upper andesite of Bearwallow Mountain Formation						
Map unit	Tbau	Tbau	Tbau	Tbau	Tbpa	Tbpa	Tbau
Map no.	9	10	11	12	13	14	15
Field no.	W-41A-80	W-41C-80	W-77-80	W-96B-80	W-83-80	W-87-80	W-198D-80
Lab no.	D-227240	D-227241	D-227243	D-227246	D-227244	D-227245	D-233968
Chemical composition (percent)							
SiO_2	59.4	61.4	54.4	57.3	53.6	55.6	58.4
Al_2O_3	16.9	16.5	16.5	16.3	16.9	16.4	16.2
Fe_2O_3	6.13	5.85	7.37	6.86	6.59	6.38	5.83
MnO	0.08	0.08	0.07	0.05	0.12	0.08	0.06
MgO	2.8	2.6	2.7	2.8	2.6	2.1	3.18
CaO	5.72	5.27	7.22	5.55	5.25	5.95	5.33
Na_2O	3.2	3.1	3.1	3.0	3.2	3.3	3.79
K_2O	2.60	3.17	2.48	3.12	4.28	4.03	2.71
TiO_2	0.92	0.85	1.23	1.08	1.38	1.33	0.85
P_2O_5	0.3	0.3	0.4	0.5	0.58	0.59	0.25
LOI	0.94	0.41	2.12	1.99	2.30	1.19	2.48
Total	98.99	99.53	99.59	98.55	98.80	98.95	99.08
SiO_2 Volatile free	60.80	62.15	58.07	59.58	55.76	57.08	60.66
Fe_2O_3 and FeO calculated from Fe_2O_3 according to oxidation ratio of LeMaitre, 1976							
Oxidation ratio	0.55	0.53	0.58	0.55	0.54	0.54	0.54
Fe_2O_3	2.58	2.57	2.92	2.88	2.86	2.80	2.52
FeO	3.20	2.95	4.01	3.59	3.36	3.22	2.98
Norms (weight percent)							
Quartz	15.02	16.71	8.22	13.14	4.49	6.70	6.39
Corundum	--	--	--	--	0.88	--	--
Orthoclase	15.72	18.96	15.10	19.17	26.30	24.44	8.97
Albite	27.71	26.55	27.03	26.39	28.16	28.66	32.99
Anorthite	24.63	22.01	30.13	22.88	23.14	24.11	28.33
Diopside wo	1.00	1.03	1.71	1.07	--	0.93	0.20
en	0.69	0.72	1.10	0.73	--	0.66	0.15
fs	0.23	0.23	0.50	0.26	--	0.19	0.04
Hypersthene en	6.45	5.83	5.83	6.52	6.73	4.71	13.34
fs	2.20	1.84	2.65	2.36	1.82	1.40	3.51
Olivine fo	--	--	--	--	--	--	--
fa	--	--	--	--	--	--	--
Magnetite	3.83	3.77	4.36	4.34	4.31	4.17	3.90
Ilmenite	1.79	1.63	2.41	2.13	2.73	2.59	1.74
Apatite	0.73	0.72	0.98	1.23	1.43	1.43	0.45

	Lower andesite of Bearwallow Mountain Formation						Older andesite
Map unit	Tbal	Tbal	Tbal	Tbal	Tbal	Tbal	Tfa
Map no.	16	17	18	19	20	21	22
Field no.	W-208A-80	W-208B-80	W-208C-80	W-208F-80	W-208G-80	W-208H-80	W-186A-80
Lab no.	D-233976	D-233977	D-233978	D-233979	D-233980	D-233981	D-233973
Chemical composition (percent)							
SiO_2	48.2	48.9	52.0	50.4	52.6	52.3	54.0
Al_2O_3	17.0	16.7	16.3	16.5	15.5	16.1	17.5
Fe_2O_3	9.41	11.0	10.1	11.2	9.12	8.78	6.62
MnO	0.11	0.16	0.14	0.15	0.12	0.11	0.09
MgO	6.12	5.08	4.37	3.97	5.58	4.47	5.14
CaO	7.50	5.58	3.44	6.89	7.00	6.83	5.75
Na_2O	2.93	3.56	2.06	3.61	3.21	3.54	3.70
K_2O	2.88	2.15	2.06	2.15	2.80	3.06	1.44
TiO_2	1.25	1.90	1.70	1.95	1.47	1.52	0.87
P_2O_5	0.60	0.59	0.55	0.68	0.62	0.73	0.18
LOI	3.99	4.13	2.70	2.63	2.41	2.34	4.53
Total	99.99	99.75	100.40	100.13	100.41	99.78	99.87
SiO_2 Volatile free	50.52	51.51	53.56	52.08	53.97	53.96	56.91
Fe_2O_3 and FeO calculated from Fe_2O_3 according to oxidation ratio of LeMaitre, 1976							
Oxidation ratio	0.60	0.60	0.59	0.59	0.58	0.57	0.59
Fe_2O_3	3.53	6.18	3.88	4.29	3.63	3.59	2.55
FeO	5.29	4.14	5.60	6.22	4.95	4.67	3.67
Norms (weight percent)							
Quartz	--	--	3.92	1.79	2.35	1.48	6.39
Corundum	--	--	--	--	--	--	--
Orthoclase	17.83	13.38	12.54	13.12	16.97	18.65	8.97
Albite	25.08	31.72	29.97	31.54	27.86	30.89	32.99
Anorthite	25.91	24.47	23.63	23.20	20.12	19.60	28.33
Diopside wo	3.74	0.26	3.60	3.13	4.74	4.35	0.20
en	2.60	0.17	2.37	1.98	3.37	3.07	0.15
fs	0.84	0.07	0.98	0.98	0.95	0.91	0.04
Hypersthene en	2.80	12.91	8.84	8.25	10.83	8.41	13.34
fs	0.91	5.19	3.68	4.12	3.04	2.50	3.51
Olivine fo	7.41	0.17	--	--	--	--	--
fa	2.65	0.07	--	--	--	--	--
Magnetite	5.36	6.32	5.79	6.42	5.40	5.37	3.90
Ilmenite	2.49	3.80	3.32	3.82	2.86	2.98	1.74
Apatite	1.49	1.47	1.34	1.66	1.61	1.78	0.45

	Older andesite		Dacite of Mineral Spring Canyon				
Map unit	Tfa	Tfa	Tmd	Tmd	Tmd	Tmd	Tmd
Map no.	23	24	25	26	27	28	29
Field no.	W-186B-80	W-186D-80	W-35-80	W-62-80	W-132-80	W-144A-80	W-209D-80
Lab no.	D-233974	D-233975	D-228851	D-227242	D-233966	D-233967	D-233969
Chemical composition (percent)							
SiO_2	58.8	59.2	66.8	60.4	61.4	60.4	64.9
Al_2O_3	18.0	17.7	15.7	16.4	17.8	16.6	15.8
Fe_2O_3	7.20	5.64	3.69	5.60	5.22	5.00	3.83
MnO	0.1	0.08	0.06	0.06	0.12	0.07	0.07
MgO	3.85	2.44	0.84	1.7	0.79	2.46	1.58
CaO	6.88	5.70	2.99	4.05	4.19	4.76	3.37
Na_2O	3.95	4.23	3.9	3.3	4.56	4.16	4.35
K_2O	1.92	1.88	3.66	3.75	3.21	2.87	3.19
TiO_2	0.91	0.64	0.63	1.02	0.86	0.85	0.67
P_2O_5	0.26	0.23	0.3	0.4	0.33	0.34	0.23
LOI	2.22	1.71	2.78	2.36	1.01	2.03	1.70
Total	99.89	99.45	101.35	99.04	99.69	99.54	99.69
SiO_2 Volatile free	56.35	60.77	67.90	62.87	62.60	62.11	66.36
Fe_2O_3 and FeO calculated from Fe_2O_3 according to oxidation ratio of LeMaitre, 1976							
Oxidation ratio	0.57	0.55	0.48	0.52	0.50	0.52	0.49
Fe_2O_3	2.91	2.41	1.81	2.54	2.47	2.26	1.65

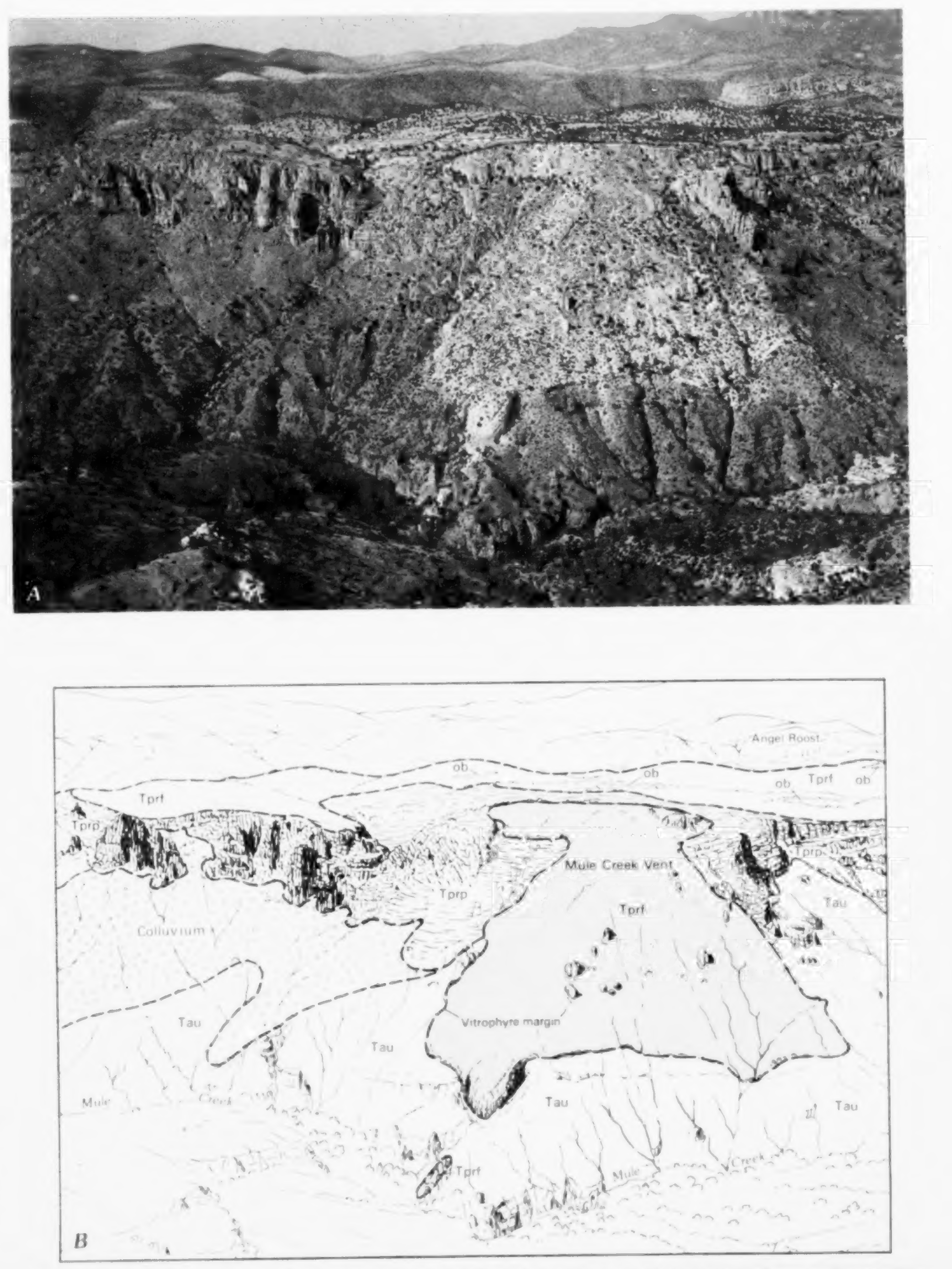


Figure 1.—*A*, Mule Creek vent, one of several vents of rhyolite of Potholes Country (Trp) which are aligned west-northwest within the Potholes Country graben. View is across canyon of Mule Creek from south rim, north of Hanna Mountain. Vertical relief from Mule Creek to north canyon rim is about 350 m (1100 ft). Rhyolite intrudes dark-brown lava flows of Bearwallow Mountain Formation (Tau) and cuts pyroclastic breccia layers (Tprp) that represent an early pyroclastic stage in the eruption of the rhyolite of Potholes Country (Tprf). *B*, Sketch of key features shown in photograph.

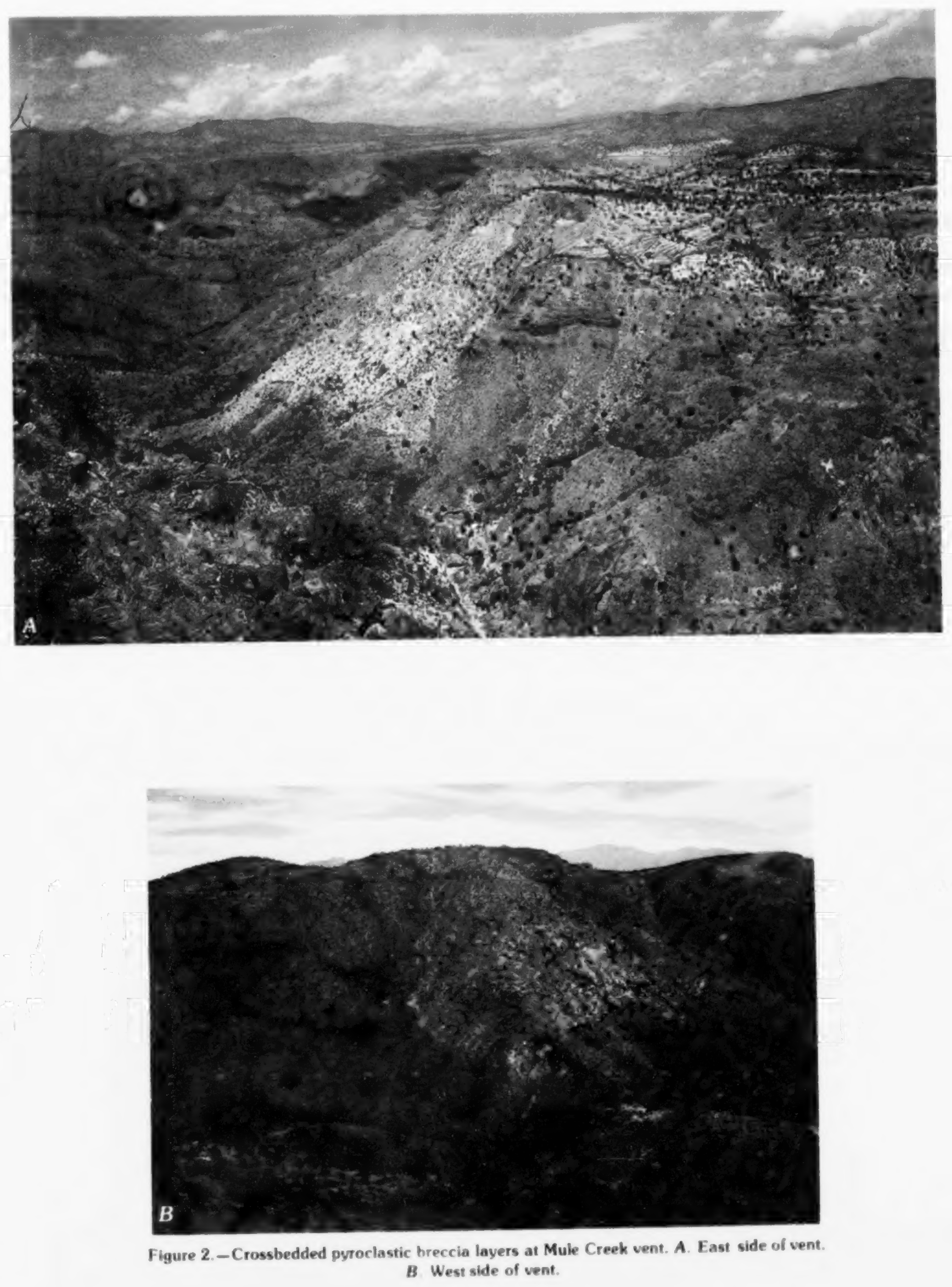


Figure 2.—Crossbedded pyroclastic breccia layers at Mule Creek vent. *A*, East side of vent. *B*, West side of vent.

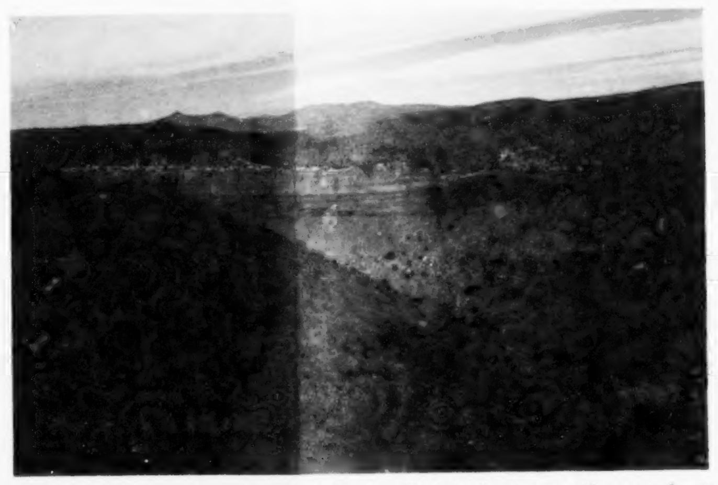


Figure 3.—Pyroclastic breccia (Tprp) of the rhyolite of Potholes Country caps ridge on southwest side of Mule Creek in sec. 2, T. 13 S., R. 21 W. Brown layers in lower half of pyroclastic sequence contain as much as 50 percent or more accidental blocks of Bearwallow Mountain Formation (Tbau). View from southeast.

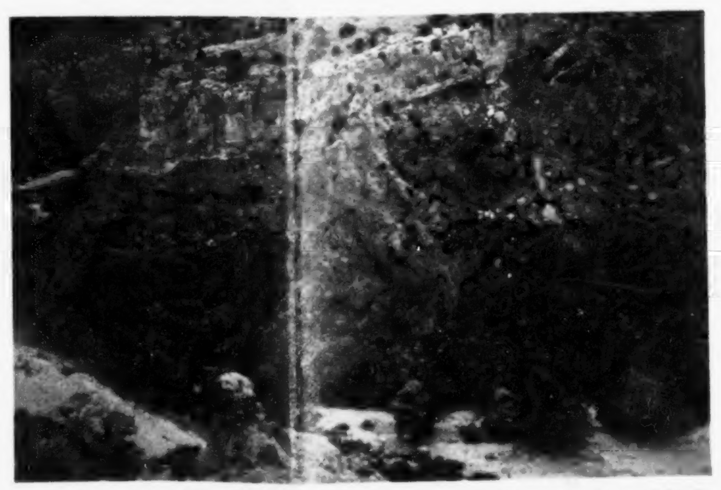
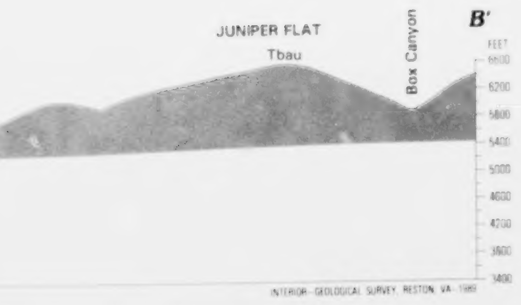


Figure 4.—Rhyolite breccia pipe (Tprb) cuts Bearwallow Mountain Formation (Tau) and rhyolite ash-flow tuff (Tar) along San Francisco River below mouth of Mule Creek, near west edge of quadrangle. View of breccia pipe on north side of San Francisco River shows thin rhyolite dikes cutting andesite to left of breccia pipe; on south side of river, not shown in photograph, breccia pipe grades into rhyolite vitrophyre at river level.



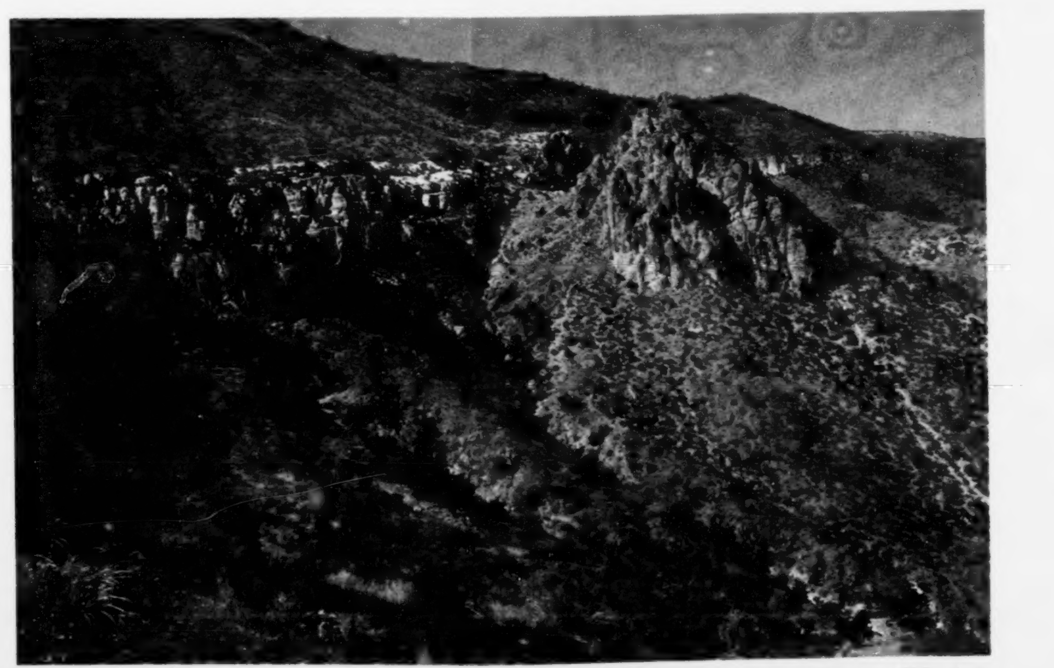


Figure 5.—Rhyolite breccia pipe (Tprb) forms a conical hill on south side of Mule Creek north of Hanna Mountain. Cliffs of ash-flow tuff (Tar), left of breccia pipe, underlie Bearwallow Mountain Formation (Tbau). View is from east.

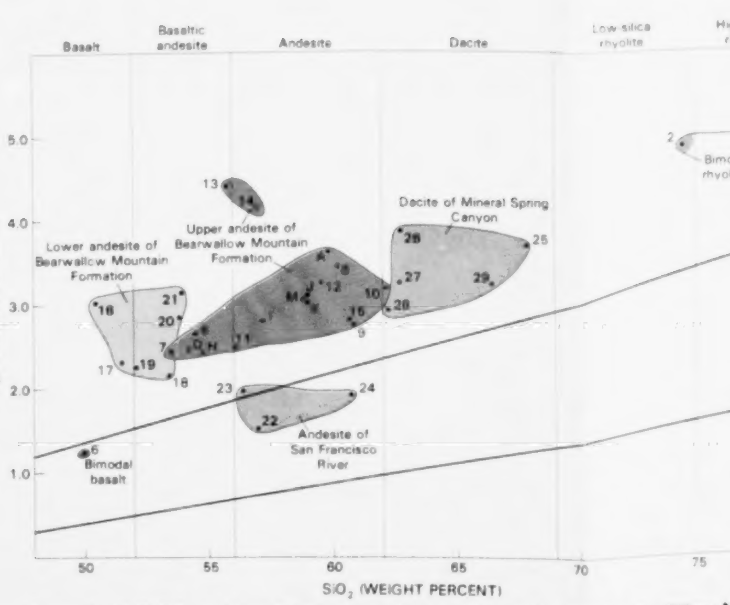


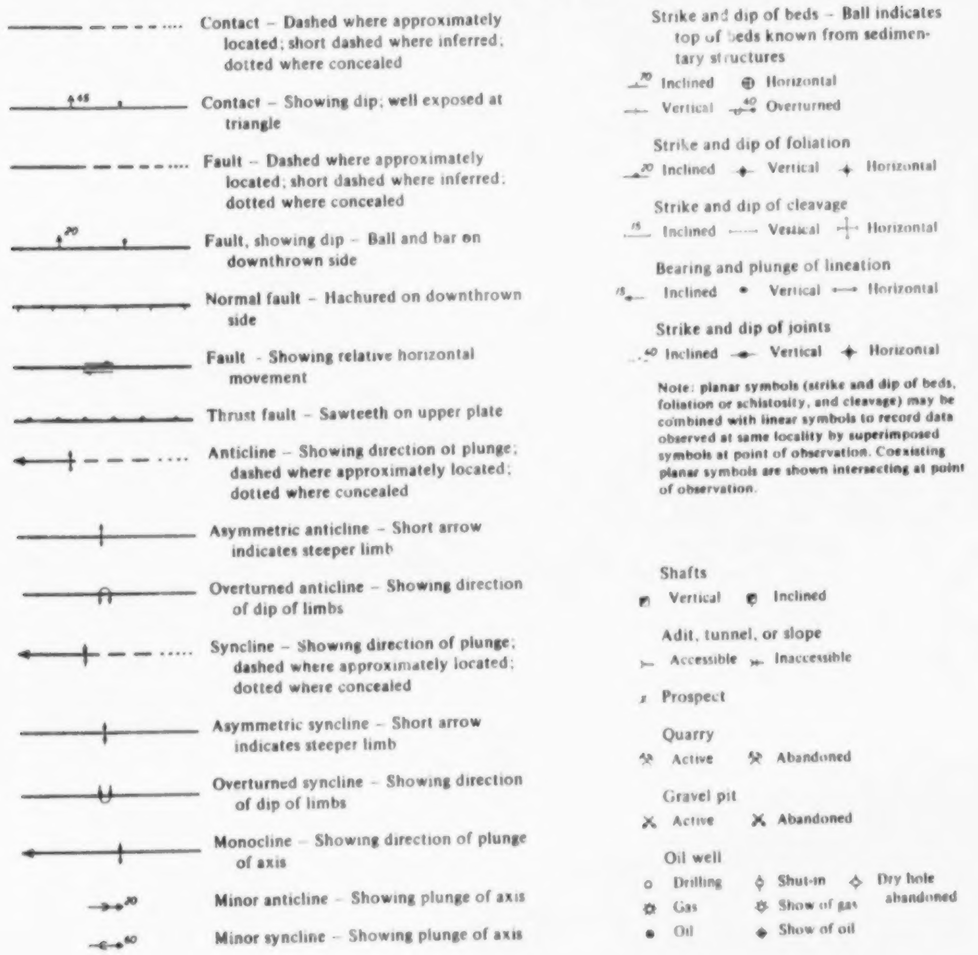
Figure 6.—K_2O-SiO_2 variation diagram for volcanic rocks in and adjacent to the Wilson Mountain quadrangle. Numbers and letters refer to table of chemical analyses (table 1) and locations on the geologic map. Discriminant lines are modified after Peccerillo and Taylor (1976). 1-5, rhyolites of the young bimodal suite; 6, basalt of the young bimodal suite; 7-15, upper andesite of Bearwallow Mountain Formation (Tbau) (13 and 14 are coarsely porphyritic (Tbpa)); A, B, D, H, I, J, K, M, upper andesite of Bearwallow Mountain Formation from the Big Lue Mountains quadrangle; 16-21, lower andesite of Bearwallow Mountain Formation (Tbal); 22-24, andesite of San Francisco River (Tfa); 25-29, dacite of Mineral Springs Canyon (Tmd).

NEW MEXICO

GEOLOGIC MAP SYMBOLS

COMMONLY USED ON MAPS OF THE UNITED STATES GEOLOGICAL SURVEY

(Special symbols are shown in explanation)



Contact – Dashed where approximately located; short dashed where inferred; dotted where concealed

Contact – Showing dip; well exposed at triangle

Fault – Dashed where approximately located; short dashed where inferred; dotted where concealed

Fault, showing dip – Ball and bar on downthrown side

Normal fault – Hachured on downthrown side

Fault – Showing relative horizontal movement

Thrust fault – Sawteeth on upper plate

Anticline – Showing direction of plunge; dashed where approximately located; dotted where concealed

Asymmetric anticline – Short arrow indicates steeper limb

Overturned anticline – Showing direction of dip of limbs

Syncline – Showing direction of plunge; dashed where approximately located; dotted where concealed

Asymmetric syncline – Short arrow indicates steeper limb

Overturned syncline – Showing direction of dip of limbs

Monocline – Showing direction of plunge of axis

Minor anticline – Showing plunge of axis

Minor syncline – Showing plunge of axis

Strike and dip of beds – Ball indicates top of beds known from sedimentary structures

Inclined Horizontal
Vertical Overturned

Strike and dip of foliation

Inclined Vertical Horizontal

Strike and dip of cleavage

Inclined Vertical Horizontal

Bearing and plunge of lineation

Inclined Vertical Horizontal

Strike and dip of joints

Inclined Vertical Horizontal

Note: planar symbols (strike and dip of beds, foliation or schistosity, and cleavage) may be combined with linear symbols to record data observed at same locality by superimposed symbols at point of observation. Coexisting planar symbols are shown intersecting at point of observation.

Shafts

Vertical Inclined

Adit, tunnel, or slope

Accessible Inaccessible

Prospect

Quarry

Active Abandoned

Gravel pit

Active Abandoned

Oil well

Drilling Shut-in Dry hole abandoned
Gas Show of gas
Oil Show of oil